NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3550 FINAL EXAM 6/99 Prof. Powers

- This exam is open book and notes.
- There are four problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be sure to include units in your answers.
- Please circle or underline your answers.
- Show *ALL* work.
- Write only your name on this sheet.
- Exams and course grades *should* be available outside the Optical Electronics Laboratory (Bu 224) on **Friday afternoon, 18 June**.
- The originals or copies of this exam and/or its solutions are not to be given or lent to anyone else.
- Enjoy your break!

Course grade: _____

1		3	
2		4	
TOTAL			

Name: _____

1. Two single-mode fibers are to be fusion-spliced together and operated in a 1300-nm fiber link. The core index of both fibers is 1.460. The emitting fiber is a 8/125 step-index fiber with a mode-field diameter of 10 μm and a fractional difference of the index of refraction of 0.2%. The receiving fiber is a 4/125 step-index fiber with a mode-field diameter of 5 μm and a fractional difference of the index of refraction of 0.3%. After the splice is made, the lateral misalignment is 1.0 μm and the angular misalignment is negligible. Calculate the expected loss (in dB) for this splice.

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2. Consider the fiber link shown in Figure 1. All components are made of 62.5/125 fiber. The excess loss of each splitter is 0.25 dB. The splice losses are 0.38 dB. The fiber losses of the coupler pigtails are negligible. Each "fiber length" is 14.7 km long and the fiber attenuation parameter is 0.45 dB/km.

   The source at "A" is observed to produce 99.8% of its original power after one year of operation. The original power in the fiber is 80 μW.

   Calculate the expected total power (in dBm) in the fiber at point "B" after 15.7 years of operation.

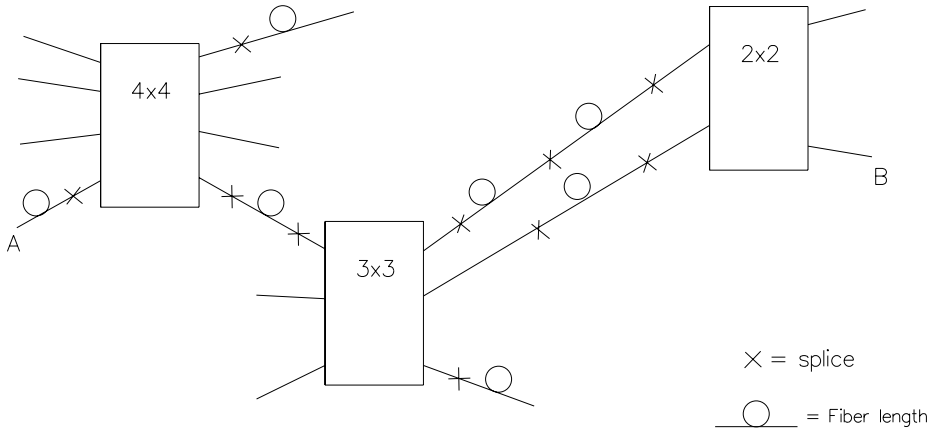

Figure 1: Fiber link for Problem 2.

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3. Consider an 8/125 singlemode fiber with a core index of 1.46 and an NA of 0.138. It is to operate with a laser source at 1550 nm with a spectral width of 1 nm. The GVD-limited ("group-velocity dispersion-limited") transmission distance is 60.0 km when RZ coding is used. Find the maximum bit-rate of the GVD-limited link.

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4. We have a long link with a series of identical fiber amplifiers that are evenly spaced. The signal power out of the amplifiers is kept constant at 2.0 mW, which is also the value of the input power to the link. The following amplifier parameters apply: $LG_0 = 2.8$, $G_0 = 33$ dB, $n_{\mathrm{sp}} = 1.30$, $\lambda = 1550$ nm, and the amplifier spectral linewidth is 30 nm. The spectral linewidth of the optical filter following each amplifier is $\Delta\lambda = 0.8$ nm.

   Calculate the maximum bit rate that could be supported at the output of the 42-nd amplifier in the chain if the desired bit-error rate is 10^{-12}.
